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CURRICULUM GUIDE

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Senior High School

CURRICULUM GUIDE

for

POWER MECHANICS 10, 20, 30

(Interim Edition)

Province of Alberta

Department of Education

September, 1965

August 23, 1966

REVISIONS IN POWER MECHANICS

A number of revisions are being made in the power mechanics course which the committee has not been able to complete.

You may use the 1965 guide for the coming year, however, consideration should be given to the following materials that are available in the revised form.

1. The Power Mechanics 10 units - Internal Combustion Engine, 4 cycle
   Internal Combustion Engine, 2 cycle
   Hydraulics
   Mechanical Transmission

   These are found on pages 53-63 of the 1966 Industrial Arts General Guide.

2. The revised Power Mechanics 20 and 30 guides are not available.

3. When purchasing equipment consult the latest equipment list and the Supervisor of Industrial Arts.

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INDUSTRIAL ARTS - POWER MECHANICS

General Information

Introduction

These courses are designed to help the student develop a scientific understanding of the mechanical conversion of chemical energy to useful and profitable work.

It is necessary for the student to learn that understanding the principles of science and mechanics and their close relationship is imperative and must precede development of practical skills in the field of Power Mechanics. A general and broad knowledge of power and its application through the medium of mechanics can be achieved through a sound and careful study of the basic and fundamental laws which govern the science of energy and its conversion to useful work. For this reason, the chosen area, the internal combustion engine and its place in the modern world, may well help the student solve and understand much that lies behind the science of mechanics and power.

General Education Value

Power Mechanics gives greatest promise of providing an understanding of mechanical industry from the standpoint of post industrial development, information about today's machines, and a foundation for understanding future mechanical developments.

It is a course that should be optional for all students in the school. The course introduces the student to the field of Power Mechanics in sufficient depth and breadth so that he may realize his abilities and interests in this particular field.

The industrial arts instructor should co-operate with the guidance personnel in the school to help them to assess the potential of their students.

Course Organization

The course is divided into four areas.

1. Maintenance
2. Power Sources
3. Electrical Systems
4. Power Transmission

Each area is taken in Industrial Arts-Power Mechanics 10, 20 and 30. The units are expanded in each succeeding year, to provide sufficient depth to challenge the student.

Scope

The Power Mechanics course should focus on the applications of scientific concepts in technology. Parallels of the utilization of scientific concepts should be drawn between their use in Power Mechanics and other technologies wherever possible with terms and practices explained scientifically.

This course will cover the study of gas, gasoline, diesel and oil engines. It will compare their differences and explain their purposes and applications. Emphasis will be put on the principles of operation, design and construction of the gasoline four-cycle engine.

Instructor's Records

The instructor should keep accurate records of:

Attendance
Test Marks
Project Marks
Exercises or Jobs
Experiments and Tests Performed
Theory Work Covered

Use of Program Outlines

Instructors are expected to use the course outlines to ascertain the content they are to teach. Some deviations from the course will be allowed providing the instructor can justify such variation to responsible officials.

Equipment

Adequate equipment should be available before the course is offered. Check with the authorized equipment lists available from your local superintendent.

General Objectives

Industrial Arts is a part of general education and as such instructors need to understand the objectives of the Alberta education program.

Functional Objectives of the Alberta Secondary Schools

(1) Personal Development

The prime aim of the school is to assist each Alberta youth in his growth towards maximum self-realization. The following definite goals are included under this heading:

i. Health and Physical fitness
ii. Mental Health

iii. Intellectual achievement
   a. Ability to think rationally, to express thought clearly and to read and listen with understanding.
   b. A broad understanding of the methods of science, its major findings and its influence on human affairs.
   c. A broad understanding of the fundamental principles of mathematics and their importance in daily living; a mastery of mathematical skills necessary for vocational competence.
   d. An understanding and appreciation of cultural heritage.

iv. The development of suitable recreational and leisure time activities.

v. The development of character manifested in sound habits of behavior in social relationships.

vi. The development of a pattern of values, attitudes, and ethical ideals which furnish justification for good habits and culminate in a philosophy of life which recognizes the importance of religion.

(2) Growth in Family Living

Each Alberta youth must learn to appreciate the unique and indispensable place in society played by the home and family and especially the influence of the family unit upon right thinking in connection with morals, institutions, and the current issues of democratic living. The school should assist him to achieve a better understanding and appreciation of:

i. The responsibilities and privileges of the members of the family group.

ii. The home as a democratic institution.

iii. The conditions essential to successful family life.

iv. The opportunities for enjoyment at home.

v. The functions and responsibilities of parents.

vi. The relationship of the family to its neighbors and the community.

(3) Growth Toward Competence in Citizenship

Each Alberta youth must be brought gradually to a realization of his position and responsibilities in the school, community, province, nation, and finally in the community of nations. The school should guide him in:

i. Acquiring insight into the historical background of contemporary society.

ii. Developing competence in meeting, and attempting to solve, public problems and issues which citizens are required to encounter and on which they must take action.

iii. Developing competence in political action at the school, community, national and world levels.

iv. Developing consumer competence.

v. Developing democratic attitudes and behavior in all social situations.

vi. Establishing loyalty to the ideals of democracy and acquiring an appreciation of his community, the province and the nation.

(4) Occupational Preparation

The school must help each Alberta youth to develop those understandings and attitudes that will make him an intelligent and productive participant in economic life; and assist him to develop saleable skills, or prepare for post-school vocational training. The youth should:

i. Become familiar with the range of vocational opportunities open to him.
ii. Learn how to take full advantage of the school and extra-school guidance services.
iii. Achieve an acceptance of his own capacities as indicated by professional analysis of interests, socio-economic status, aptitudes, personality, and native intelligence.

Objectives of The Senior High School Industrial Arts Program

The Industrial Arts program helps to attain the functional objectives of Alberta Secondary School Education as set forth above.

Within the scope of these general objectives the unique contributions made possible through Industrial Arts courses are summed up in the following objectives:

Industrial Arts courses will provide an opportunity for students:

(1) To develop an understanding of related technological clusters and the interrelationship of the technologies within the cluster areas.
(2) To develop an understanding of the applications of the academic disciplines in an industrial environment.
(3) To study and work in an environment which stimulates the individual to discover and develop his interests and talents.
(4) To develop an understanding of man's changing role in an advancing industrialized society.

POWER MECHANICS 10

SPECIFIC OBJECTIVES

1. To help the student understand the many basic laws and principles of science at work in Power Mechanics and relate these laws and principles to the vast area of power technology.
2. To familiarize the student with the construction and requirements of machines which convert energy to useful work.
3. To develop problem-solving skills related to materials and processes in Power Mechanics.
4. To develop the student's ability to work with others through group experiences in the laboratory.
5. To help the student understand, control and maintain the power machine.

MAINTENANCE AND TUNE-UP

Course Content

DO	KNOW
1.	1.
(a) Develop a total cost chart for a piece of equipment - i.e. family refrigerator, automobile.	(a) Theory of maintenance including the following topics: -Machine life (economics) -Wear of components - moving and non-moving parts. -Machine efficiency -Replacement of parts -Inspection -Safety
(b) Perform an inspection on a complex piece of equipment - i.e. automobile.	
(c) Inspect body, doors, fenders, bumpers and all glass.	
(d) Hoist inspection of suspensions, springs, drive shafts, universal joints, engine mounts, exhaust system, fuel lines, oil pans, transmission and differential seals, brake lines and tires.	
2.	2.
(a) Perform lubrication of a complex piece of equipment - i.e. automobile.	(a) The principles of lubrication including the following topics: -friction -requirements of a lubricant, speed, pressure, heat, clearances, contaminants. -kinds of lubricants, solids, graphite, molybdenum disulfide silicones, semi-solids as scaps, greases, liquids -sources of lubricants - petroleum industry
(b) Use lubrication charts.	
(c) Change lubricants - engine, gear-boxes.	
(d) Greasing and oiling.	
(e) Service of air cleaners, breathers and filters.	

DO	KNOW
3.	3.
(a) Wash and wax vehicles using sponges, chamois, cleaning agents, solvents and proper waxes.	(a) Protection -paint -other coatings, under-coating, waxes -cleanliness
(b) Clean all glass, polish chrome, vacuum car interior and brush upholstery and door panels.	
4.	4.
(a) Perform experiments with friction-sliding, rolling, wet and dry surfaces.	(a) The principles of the various types of bearings - dissimilar metals, ball, roller, barrel, taper, nylon, teflon.
(b) Disassemble and assemble and adjust different types of bearings - e.g. wheel bearings.	(b) The principles of minimizing of friction.
	(c) Pressure - direction of loads and preloading of bearings.
	(d) The appearance of serviceable and unserviceable bearings, cups, cones, bearing seals.
	(e) The importance of lubrication in anti-friction bearings, the difference in bearing types and the need for proper adjustment for clearance on all types of anti-friction bearings.

Instruction Sheets

Teacher-prepared shop notes (which are to be completed by students using prescribed references).

Lubrication Check Charts - All Oil Companies.

POWER SOURCES

DO	KNOW
1.	1.
(a) Read and review information on the definitions of work, energy and power in suggested primary references.	(a) The meaning of work, energy, and power. (b) Measurement of work. (c) Measurement of power. (d) Calculating efficiency and power. (e) Physical properties of metals.

	DO	KNOW
2.	Inspect, service, check, start and stop the internal combustion engine, which will include: (a) the one-cylinder two-cycle gasoline engine. (b) the multi-cylinder four cycle gasoline engine.	2. (a) Differences among internal combustion engines. (b) Identify the necessary and visible components of the various types of engines. (c) Understand safety features of engines and safe control of the power unit.
3.	(a) Experiment with compression gauges, vacuum gauges on live multi-cylinder engines, both diesel and gasoline. (b) Experiment with vacuum tests on the venturi of the carburetor. (c) Take compression tests (both wet and dry).	3. (a) Principles of science involved in the intaking of air fuel mixtures and compression of gasses. (b) How to calculate compression ratios, laws which govern the intaking, compressing, and combustion, exhausting of gasses.
4.	(a) Disassemble and reassemble simple single-cylinder gasoline engines of the two-stroke cycle and the four-stroke cycle. (b) Use necessary tools and orderly procedure in disassembling and assembling. (c) Maintain bench and work area with the neatness of the science laboratory.	4. (a) Understand differences in construction. (b) The need for precision and care in assembling. (c) The name and function of both stationary and moving components.
5.	(a) Trace the lubrication system.	5. (a) Principles of lubrication and its relation to carburetion and cooling systems. (b) The operating principles of the various oil pumps. (c) Why by-pass and relief valves are used and understand the basic principle on which they operate.
6.	(a) Trace and explore the cooling systems, both air and liquid. (b) Examine radiators, hoses, water jackets, thermostats, water pumps, fans and fan belts. (c) Perform experiments on the freezing points of various ethylene, glycol and water solutions.	6. (a) The need for cooling of power sources. (b) The principles of heat transfer-radiation, conduction, convection. (c) Methods of cooling and kinds of coolants - air, water, ethylene glycol, liquid sodium.

DO	KNOW
	6. (d) Effects of pressure on boiling point. (e) Relationships between cooling system and lubrication and fuel systems.
7. (a) Disassemble, assemble, inspect, clean and check carburetors and simple fuel injection pumps. (b) Set carburetors, automatic and manual choke systems. (c) Set mixture controls on carburetors. (d) Disassemble and assemble the diaphragm-type fuel pump.	7. (a) The scientific principle utilized in the preparation of fuel and air combustion, carburetion injection. (b) The actions of the carburetor-venturi (Bernoulli's principle) automatic choke (bimetallic strips) circuits and mixture controls. (c) Safety procedures in handling fuels.
8. (a) Trace, examine, disassemble and assemble both the magneto and the battery ignition system. (b) Check battery ignition distributor mechanical and vacuum advance. (c) Trace complete ignition system, switch, distributor circuit, coil circuits and high voltage lines to spark plugs. (d) Examine, study and service the wet storage battery.	8. (a) The need for ignition and the necessity of precision timing. (b) The principles and operation of the ignition system - high voltage - low voltage - transformer - action of coil - condenser action.

ELECTRICAL SYSTEM

Course Content

1. Ignition (a) Trace, inspect, study the entire ignition circuit. (Shop models) (All circuits). (b) Study, inspect, disassemble and reassemble complete distributor unit.	1. (a) The electron theory. (b) Units of electrical measurement. (c) Ohms Law.
2. Generator (a) Disassemble, inspect, study and reassemble the generator (shop units). (b) Trace both field and armative circuits on the generator.	2. (a) The definition of the generator. (b) The principles of the generator. (c) Commutation. (d) Production of the magnetic field. (e) Theory study of regulation (brief).

DO	KNOW
3. The Alternator	3.
(a) Disassemble, inspect and study and reassemble the alternator (shop model Delcetron).	(a) Induction of alternating current.
(b) Trace and study rotor and stator windings and circuits on the alternator.	(b) Rectification of alternating current by the disc or diode type rectifier.
4. The Cranking Motor	4.
(a) Disassemble, inspection, study and assembly of the electric starting or cranking motor.	(a) Definition of cranking motors.
(b) Trace field, armature and brush plate circuit of starting motor.	(b) The operation of the electric cranking motor.
(c) Inspect and study cranking motor drive mechanisms.	
5. The Auto Lighting System	5.
(a) Inspection and study of switches 1. manual 2. magnetic 3. reostat with thermostatic circuit, breaker 4. brake hydraulic switches	(a) The principle of series and parallel circuits.
(b) Inspect, study and service fuses and circuit breakers (lighting and horn relay).	(b) The complete light circuit system.

Projects and Experiments

Preparation of complete circuit panel for shop study. Group work and experimentation on actual shop models of all electrical equipment.

POWER TRANSMISSION

Course Content

1.	1.
(a) Trace power flow through various mechanical devices i.e. automobile, tractors, earth moving equipment.	(a) The need for power transmission.
(b) Compare output with input of a power transmission system.	(b) Mechanical advantage, the relationship between force and distance - torque and speed.
	(c) Directional changes in power transmission.
	(d) Efficiency of power transmission - minimizing frictional losses.

DO	KNOW
2.	2.
(a) Disassemble, inspect, study assemble and adjust various types of clutches.	(a) The need for disconnecting power flow. (b) Clutch systems - dog, sliding gear, one way, centrifugal, cone, single plate, multiple discs. (c) The principles of wet and dry clutch systems - friction materials area - pressure - mechanical and hydraulic controls. (d) Methods of engagement.
3.	3.
(a) Disassemble, inspect, calculate ratios and assemble various gear boxes. Represent all types of gearing e.g. automobile transmissions, truck transmissions, overdrives, motor scooter, power take-off steering boxes, rear axles, automatic transmissions.	(a) The principles of power transmission utilizing gears. (b) Calculation of gear ratios. (c) Types of gears - straight, spur, helical cut, bevel, spiral bevel, hypoid, worm, rack and pinion. (d) Arrangement of gears in gear sets - countershafts, idlers, planetary, differential, synchronized.
4.	4.
(a) Inspect various kinds of drive trains. (b) Disassemble, inspect for wear, assemble and align a drive train using shafts e.g. automobile drive shaft.	(a) The principles of power transmissions utilizing shafts. (b) The need for shaft supports, bearings, mounting blocks. (c) Need for flexibility in the drive train - universal joints - couplers, flexible shafts.
5.	5.
(a) Inspect a belt drive for wear - belt - pulley. (b) Adjust belt tension. (c) Adjust pulley alignment. (d) Inspect chain drive for wear. (e) Adjust chain tension.	(a) The principles of flat and "V" belt pulley systems. (b) The principles of chain drive - roller chains - toothed chains.
6.	6.
(a) Inspect a closed hydraulic system - hydraulic brakes - tractor hydraulic system. (b) Check for leaks. (c) Bleed air out of a system. (d) Adjust controls and mechanical connections.	(a) The principle of a closed hydraulic power transmission system. (Pascal's Principle) (b) The function and principles of operation of various hydraulic pumps - plunger, centrifugal gear, rotor, vane.

DO

KNOW

6. (continued)...

(c) Utilization and control of hydraulic pressure - cylinders, valves - lines.

(d) The principle of dynamic hydraulics - impellors, pumps, stators, turbines.

7.

(a) Other means of power transmission - electric - magnetic - pneumatic.

POWER MECHANICS 20

Course Content

That a student should be able to do:

MAINTENANCE AND TUNE-UP

	DO	KNOW
1.		1.
(a)	Carefully examine steering knuckles, tie rods, steering box, king pins, or ball joints.	(a) The importance of preventative maintenance.
(b)	Check engine compartment for fan adjustment, engine oil level, loose components, battery, air cleaner.	(b) Safety of operation and control. Understand the principles of the auto front end and steering.
2.		2.
(a)	Check tire pressures and rotate wheels, repair flats by both the cold and hot patch method.	(a) Review A, B and C Power Mechanics 10.
3.		
(a)	Oil generator, starter and distributor base, grease water pump if so designed.	
4.	General (Basic) Maintenances	4.
(a)	Study the clutch and drive line system	(a) The importance of stable, in-line rear suspension.
(b)	Inspect, check and test fly-wheel.	(b) The principles of off-centre drive systems and dynamic balance.
(c)	Remove a standard transmission and clutch.	(c) A reasonable approach to clutch, drive line and rear suspension trouble shooting.
5.	General Maintenance	5.
(a)	Disassemble front wheels for spindle, seal and bearing inspection.	(a) The principles of centrifugal forces and the need for dynamic balance.
(b)	Inspect, service and balance wheels.	(b) An understanding in using precision alignment tools.
(c)	Check and set chamber, castor, toe-in.	

DO	KNOW
6. General (Basic) Maintenance	6.
(a) Examine, inspect and make minor repairs to the brake system.	(a) The extreme precautions necessary in maintenance of brake systems.
(b) Inspect and repair the brake hydraulic system.	(b) Mechanical advantages of hydraulics. How to calculate mechanical advantage, pressures, and force. The principle of the lever and its application in the hydraulic brake system.
(c) Service and kit replacement of master cylinder.	(c) Understanding the vacuum operated power brake.
7. General Maintenance	7.
(a) Service a water pump.	(a) The importance of the cooling system and the primary points to inspect.
(b) Inspect and service a thermostat.	
8.	8.
(a) Take compression and vacuum tests.	(a) A few of the major trouble spots and how to prevent problems.
(b) Inspect and tighten manifolds and replace gaskets if necessary.	
9.	9.
(a) Test fuel pump for correct pressure.	(a) Understand the operation of the fuel filters.
(b) Test intake manifold for vacuum.	(b) The importance of atmospheric pressure to the auto fuel system.
(c) Check carburetor for dirt and carbon and remove if necessary.	(c) How manifold vacuum controls air and fuel mixing.
	(d) Why chokes are used.
	(e) Why idling circuits are necessary.
10.	10.
(a) Remove distributor for inspection repair and servicing.	(a) Ignition problems and make repairs with unnecessary guess work.
(b) Test distributor on Syncograph unit.	(b) The working principle of the coil and condenser.
(c) Time ignition with flywheel or crank pulley timing marks (according to manufacturers' specifications).	(c) The need for ignition advance and retardation.

POWER SOURCES

DO

Review and work on units listed under Power Mechanics 10 with greater detail and depth.

1.
(a) Identify parts of the multi-cylinder diesel engine.
(b) Experiment with fuel mixture controls.

2.
(a) Use necessary tools and orderly procedure in disassembling and assembling.

3.
(a) Disassemble, inspect, and reassemble several types of oil pumps, oil by-pass valves, oil pressure relief valves, unrestricted oil galleries, metered lubrication orifices.

4.
(a) Check gaskets, by-passes, distributor tubes and temperature gauges.
(b) Test cooling system.

5.
(a) Examine carburetor, linkage, high speed circuits, idling circuits, accelerator pump systems and circuits.

6.
(a) Examine points, condensors, rotor and distributor caps.
(b) Test a distributor and magneto.

KNOW

The student must know the Power Mechanics 10 units and in addition the following:

1.
(a) Reasons for variations in vacuum readings and why diesel engines have no vacuum readings.
(b) Basic chemistry of combustion and thermo-dynamics.

2.
(a) To recognize the extreme importance in the order of assembly and installation of parts.

3.
(a) And understand the various types of filtering systems and why they are used.

4.
(a) The principle of centrifugal pumps.
(b) The principles of various types of thermostats.

5.
(a) The principles of fuel injection, the operation of the injection pump and nozzles.

6.
(a) The principle of the distributor.
(b) The principle of induction in the magneto (both types).
(c) The necessity of setting distributor points. Maintenance and care of the ignition system.
(d) The principle of the wet storage battery.

DO	KNOW
7.	7.
(a) Disassembly and assembly of partial engine blocks.	(a) The principle of operation for the two-and four-stroke cycle engine.
(b) Install crankshaft, camshaft and timing gears.	(b) Valve arrangements and operation.
(c) Calculate engine power by various methods and using various formulas.	(c) Timing of piston and valves.
	(d) Kinds of horsepower.
8.	8.
(a) Disassemble and assemble a generator and starter.	(a) How the generator and alternator operates.
(b) Inspect and test charging systems and regulators.	(b) The principles of induction in both alternating and direct current charging systems.

ELECTRICAL SYSTEM

1. Ignition	1.
(a) Inspect, and test coil and condenser (after study of cut-a-way models).	(a) The step-up and step-down transformer and its principles and mathematics.
(b) Work on magneto to both flywheel type and self-contained unit.	(b) The condenser and its principle.
	(c) The impulse coupling on magnetos and their principles.
	(d) Principles of electricity.
	(e) Static electricity.
2. The Generator	2.
(a) Turn armature commutator bars and undercut mica.	(a) The principles of the generator.
(b) Inspect, check, test, study, brush plate and brushes.	(b) Commutation.
(c) Growler test armature.	(c) Generators require regulators.
	(d) Types of generator windings.
	(e) Third brush generators.
3. The Alternator	3.
(a) Test stator and rotor for continuity and resistance.	(a) Electrical terminology
(b) Examine, test and study disc rectifiers and the diode rectifier system.	(b) The Hole theory for diode rectification.
(c) Test assembled alternator with serviceable regulator on test stand.	
4. The Cranking Motor	4.
(a) Test cranking motors.	(a) The construction of the simple series direct current motor.
(b) Inspect and study cranking motor control.	(b) The bendix drive device.
(c) Trouble shoot for cranking motor problems.	(c) Inertia drive devices.

DO	KNOW
	4. (d) The over-running clutch drive device. (e) The Dyer drive mechanism. (f) Gear reduction drives.
5. The Battery (a) Test battery (b) Add water (c) Add acid	5. (a) Principles of chemical processes in the battery. (b) Care and maintenance of the battery. (c) Charging and discharging principles of the battery. (d) Direction of current flow. (e) Battery ratings.
6. The Auto Lighting System (a) Inspect, test and service relay. (b) Test and Service - 1. Fuel gauge 2. Oil pressure gauge 3. Engine temperature gauges	6. (a) The principle of magnetic switches, relays and current limit relays. (b) Principles of the solenoid relay. (c) Overdrive solenoids and circuit systems. (d) The balancing coil type gauge. (fuel and oil pressure)

POWER TRANSMISSION

1. (a) Disassemble, inspect, study and assemble clutch units. 1. Dry - single disc. 2. Dry - double disc. 3. Wet - single disc. 4. Dry - multi disc.	1. (a) Care and maintenance of the transmission. (b) Reasons for construction and design of transmissions. (c) The principles of the clutch system and its purpose.
2. The Automatic Transmission (a) Inspection and study of the fluid coupling (shop units only).	2. (a) Principles of fluid movements (Rotary and Vortex). (b) Torque converters, speed, reduction and power increase.
3. Power Transmission (a) Inspection and study of all types of drive shafts and universal joints (shop units only).	3. (a) The various types of drive systems, shafts and universals. (b) The principles involved in the various universal joints and drive lines (plus fluid couplings)

DO	KNOW
4. The Rear Axle	4.
(a) Disassembly and assembly of differential units.	(a) The two-speed rear axle.
(b) Inspection, disassembly and assembly of non-slip rear axle units.	(b) The various types of rear axles. 1. Ring and ring gear. 2. Worm and ring gear. 3. Herringbone gear drives.
(c) Adjustment and setting of crown and pinion gear in rear axle carriers.	
5. Auxiliary Power Transmission Systems	5.
	(a) The power advantage in hydraulic systems and the principles of operation.
	(b) Vacuum and pneumatic systems.

POWER MECHANICS 30

Total 144 Hours (18 hours in practical shop and 18 hours theory in all four areas)

Power Sources

General review of course Power Mechanics 10
Extension of detail for Power Mechanics 20
All units not covered in Power Mechanics 10 and 20

Maintenance and Tune-Up

Same procedure as for Power Sources

Electrical System

Same procedure as for Power Sources.

Power Transmission

Same procedure as for Power Sources.

The above review and study will be followed by the following course plan which will supplement and broaden the scope and depth of the Power Mechanics 30 section.

Course Content

What the student should be able to:

DO	KNOW
MAINTENANCE AND TUNE-UP	
1.	1.
(a) Check chassis frame, for cracks, alignment and loose or broken mounts.	(a) The importance of thorough examinations and inspections.
(b) Check master brake cylinder.	
(c) Check engine compartment with check sheet.	
2. General (Basic) Maintenance	2.
(a) Inspect, disassemble, test, service and assemble pressure plates.	(a) The difference in clutch, driveline and suspension systems used in various makes of autos.
(b) Inspection and service of clutch plate and throughout bearing.	
(c) Re-assembly of clutch unit and replacing transmission.	
(d) Testing and setting of clutch unit.	
(e) Remove and replace universal joints.	
(f) Inspect, service or replace rear wheel axle seals.	
(g) Inspect, check, service, remove and replace rear spring, shackles, anchors, centre bolts and U bolts.	

DO	KNOW
3. General Maintenance	3.
(a) Inspect, service and balance wheels.	(a) To understand when axles and spindles are serviceable or require attention.
(b) Use front end aligning equipment and tools.	(b) The multiplicity of factors which provide for efficiency and safety in automobile control.
(c) Inspect, service and replace king pins or ball joints (followed by resetting of wheel alignment).	
4. General (Basic) Maintenance	4.
(a) Service and repair of wheel cylinders.	(a) The principles involved in hydraulics.
(b) Bleed a brake system.	(b) Understanding brake fluids, and the rubber seals which act as pistons.
(c) Change brake shoes and inspect brake drums.	(c) General knowledge of air brakes and combinations of air, hydraulic systems.
(d) Inspect and repair drive line emergency brake system or rear wheel.	(d) Basic understanding of electric brake systems.
(e) Inspect, repair or replace emergency brake linkage or cables.	
(f) Experiment on vacuum booster brake units.	
5. General Maintenance	5.
(a) Inspect front and rear engine oil seals.	(a) The order and sequence of engine inspection and service.
(b) Inspect and remove oil pan for gasket service or change.	(b) How to look for trouble by isolating major systems on the power plant.
(c) Inspect and replace oil pressure lines. (The above items to be done on auto shop chassis model only, not on road worthy vehicles.)	
6.	6.
(a) Check all curburetor linkage and fittings.	(a) The purpose for the venturi.
(b) Inspect and try heat riser on exhaust manifold for seizures.	(b) The function of high speed jets and the accelerator pump circuit.
(c) Disassemble, clean and reassemble carburetor making sure all gaskets and seals are replaced and all settings adjusted to manufacturers' specifications.	(c) The principle of the float and the needle and seat valve.
(d) Adjust the carburetor for idling and mixture control.	(d) Understand the need for proper air and fuel ratios.
	(e) The relationship of carburetion to ignition.

DO	KNOW
7.	7.
(a) Checking and testing of coil and condenser.	(a) The resistance of high compression pressures to spark jumping in the combustion chamber.
(b) Checking mechanical and vacuum advance units.	(b) The use of resistors and suppressors in the ignition circuit.
(c) Inspection of distributor caps, rotors and high voltage leads.	(c) The relationship of ignition and carburetion.
(d) Servicing, inspecting and testing of spark plugs.	
(e) Use timing light.	

POWER SOURCES

1.	
(a) Examine and test exhaust gasses.	
(b) Experiment with operation of engines at various temperatures.	
2.	2.
(a) Check and examine the various types of oil filters, breathers, coolers and reservoirs.	(a) The requirements of lubricants how they are produced, their qualities and chemistry.
	(b) The requirements of lubricants and the terminologies which pertain to them.
	(c) Properties of lubricants.
	3.
	(a) The principles of the pressurized cooling system.
	(b) Testing procedures and understanding various types of coolants.
	(c) The need for anti-freeze and the testing of its effectiveness.
4.	4.
(a) Examine governors on fuel injection pumps.	(a) The need for governors on injection pumps.
(b) Check, disassemble and assemble fuel injection nozzles.	(b) Auxiliary transfer pumps diesel fuel filters, by-pass relief valves, high pressure fuel lines.
(c) Prepare copper tubing for flaring, double flaring and ferroul type unions.	
5.	
(a) Trace, examine, disassemble and assemble both the magneto and battery ignition system.	

DO	KNOW
6.	6.
(a) Examine magneto and fly wheel magneto ignition systems.	(a) How to recharge the wet storage battery.
(b) Test battery with hydrometer.	
(c) Test battery under load.	
7.	7.
(a) Removal and replacement of pistons, connecting rods and rings.	(a) The principle of the fly wheel.
(b) Examination and installation of bearings.	(b) The principle involved in the reciprocating and rotary motions of engine pistons and crankshafts.
(c) Remove, inspect and replace valve lifters.	(c) About dead spots, power lap, valve lag, valve lap.
(d) Remove, clean, grind and replace valves.	(d) Engine terms.
(e) Clean and grind valve seats.	(e) Firing orders.
(f) Set valve tappets.	(f) Kinds of horsepower.
(g) Clean and replace cylinder heads.	(h) Understanding the intake systems and exhaust systems of both two-and four-stroke cycle engines.
(h) Calculating of engine power by various methods and using various formulas.	
(i) Tighten cylinder head bolts in required order.	
8.	8.
(a) General inspection checking and testing of electrical system.	(a) The principle of starter operation.
(b) Remove clutch pressure plates, release bearings, and reassemble same.	(b) And develop an understanding of the electrical system required on the internal combustion engine.
(c) General inspection, set and test clutches.	(c) And understand how power is transferred from the internal combustion engine.

ELECTRICAL SYSTEM

1. Ignition	1.
(a) Inspect, test and service high voltage lines and spark plugs.	(a) Electrical circuits and their application.
(b) Service wet storage battery.	(b) Electrochemical source of electrical energy.
2. The Generator	2.
(a) Inspect, test and service field windings (continuity and resistance tests).	(a) The shunt wound generator.
	(b) The theory of regulator operation.
(b) Test rebuilt generators for output (on generator test unit) with serviceable regulation.	(c) Characteristics of modern regulators.
	(d) Basic understanding of the various types of regulators. (Study of regulators and current and voltage regulators will be basic and elementary).

DO	KNOW
3. The Alternator	3.
(a) Trace and study rotor and stator windings and circuits on the alternator.	(a) Rectification of alternating current by the disc or diode type rectifier.
4. The Cranking Motor	4.
(a) General service for cranking motor armature, fields, brushes and end plate bearings or bushings.	(a) The principles of the simple series direct current motor. (b) The manual type cranking motor switches. (c) Magnetic switches. (d) Magnetic and vacuum switch controls. (e) Solenoid switches and shifts. (f) The solenoid-operated series parallel switch.
5. The Battery	5.
	(a) Temperature and battery efficiency and other battery characteristics. (b) Specific gravity and its application to the battery. (c) Battery safety. (d) Dangers of incorrect battery installation and overcharging. (e) Care of stock batteries.
6. The Auto Lighting System	6.
(a) Examination of tell-tale relay units with minor service. (b) Service electrical appliances windshield wipers, clocks, lighters, park, brake and signal turn light system.	(a) The thermostatic type fuel gauge and water temperature gauge. (b) The understanding of continuity tests and resistance tests on all circuits. (c) The horn system.

POWER TRANSMISSION

1.	1.
	(a) Trouble shooting for clutch problems of all types of dry or wet clutch systems.
2. The Automatic Transmission	
(a) Disassemble and assemble (with service manual and supervision). (Shop units only) (b) Inspect and study automatic transmission selector assembly.	

DO	KNOW
3. The Rear Axle	3.
(a) Test for run-out on crown gear and carrier.	(a) Control system for two speed axle systems.
(b) Set pinions and carrier bearings for proper clearance in rear axles.	
4. Auxiliary Power Transmission Systems	4.
(a) Inspect, service, disassemble and assemble power vacuum brake units and controls (shop units only).	(a) Theory unit only. The power transmission involved in electrical motor operated units 1. Brakes (magnetic) 2. Control system 3. Selectors and relay units
(b) Service and study brake operating diaphragm units and all controls.	(b) The application of the lever to power transmission.
(c) Disassemble and assemble electric brake systems (magnetic shop units only).	(c) The various combinations of power transfer and the application of science to alter or change 1. speed 2. force 3. direction 4. mechanical advantage
(d) Bench work on mechanical steering units.	
(e) General survey, inspection and project work on combination power transmission units 1. Vacuum and hydraulic 2. Hydraulic and compressed air 3. Hydraulic and electrical 4. Hydraulic and mechanical	

Reference List

1. Power Mechanics, George E. Stephenson, Delmar Publishing Inc.

2. Automotives Essential, Ray F. Kuns, The Bruce Publishing Company

3. Automotive Electrical Equipment, William H. Crouse, McGraw-Hill Book Co.

4. Motor Services, Automotive Encyclopedia, Jud, Purvis & William K. Toboldt, The Goodheart-Willcox Company Inc.

5. Automotives Mechanics, William H. Crouse, McGraw-Hill Book Co. Inc.

6. Automobile Repair Manual, R. W. Bruce, Midland, Ontario.

7. Short Stories of Science and Invention ...
   General Motors Manuals
   General Motors Products of Canada
   Service Promotion Department
   Oshawa, Ontario.

8. National Fluid Power Association, P.O. Box 49, Thiensville, Wis.

Teaching Aids

Service Manuals	Available from: General Motors Limited Ford Motor Company Chrysler Corporation Limited
Engine Charts and Plans	Available from: General Motors Limited Ford Motor Company Chrysler Corporation Limited Caterpillar Tractor Company International Harvester Company Ltd.
Films	Shell Oil Company of Canada Ltd. General Motors Limited
Service Bulletins and Charts	Delco Remey Company Limited
Catalogues and Service Bulletins	Motor Car Supply Limited Snap-On Tools Limited
Service Bulletins and Manuals	General Motors Limited Ford Motor Company Chrysler Corporation Delco Remy Company Limited

Cut-a-way models of all electrical equipment

Projects and Experiments

1. Preparation of simple hydraulic systems (using hydraulic brake units and hydraulic steering pumps and cylinders).

2. Preparation of simple magnetic control units.

3. Plan and construct simple vacuum operated units (using power-vac brake assemblies).

4. Demonstration materials from industry as well as automotive components may be used to teach power transmission concepts.

Instructional Helps

Projects and Experiments

1. Making of cut-away models of internal combustion engine components (which will in turn provide development of hand skills in filing, fitting, drilling, grinding, sawing and soldering).
2. Experimenting with self-made models of venturi tubes.
   Experiments with the prony-brake.
   Experimentation with self-made combustion chambers and self-designed high voltage ignition systems.

Instruction Sheets

1. Distribution of weekly prepared information sheets, designed as semi-finished notes. Such sheets to reveal the depth and scope of the course requirements.
2. Job sheets, instructing students of methods and procedures for disassembly and assembly of components, and stressing phases of major importance.
3. Question sheets on jobs or projects completed.
4. Assignment sheets for major weekly assignment.
5. A minimum of ten information sheets on the ten major areas of the course stressing the principles and laws involved in the operation of the unit concerned.

In this course the information sheets should deal with:

1. Measurement of work, efficiency and power.
2. Operation of the internal combustion engine.
3. The principles of combustion.
4. Shop procedure.
5. Principles and properties of lubrication.
6. Cooling systems and their importance.
7. Carburetion.
8. Electrical induction.
9. The principles and laws of the internal combustion engine.
10. Auxiliary power units and the transfer of power.

Demonstration Materials

Demonstration materials from industry may be used to an advantage for the teaching of power mechanics concepts. However, the following automotive components are easily obtained and may be used as a starting set of demonstration materials. Note the numbers suggested for the Industrial Arts, General course (G) and the cluster course (C).

G	C	
4	4	Single-cylinder gasoline engines. (two, two-stroke and two four-stroke cycle units)
2	2	live and operating multi-cylinder gasoline engines. (four-stroke cycle)
1	3	Semi complete engine blocks. (six-cylinder units preferred)
2	10	Single barrel carburetors. (Carter preferred)
2	10	Distributors and coils.
1	5	Generators (Delco Remey)
2	9	Oil pumps (3 of each)(Spur gear, rotary and reciprocating).
1	4	Water pumps.
1	4	Starters (complete with solenoid).
2	5	Thermostats for experimentation purposes.
1	10	Diaphragm type fuel pumps.
2	2	Wet storage batteries (one six and one 12 volt)
		Cut-away models of all electrical equipment.

Demonstration materials from industry as well as automotive components may be used to teach power transmission concepts.

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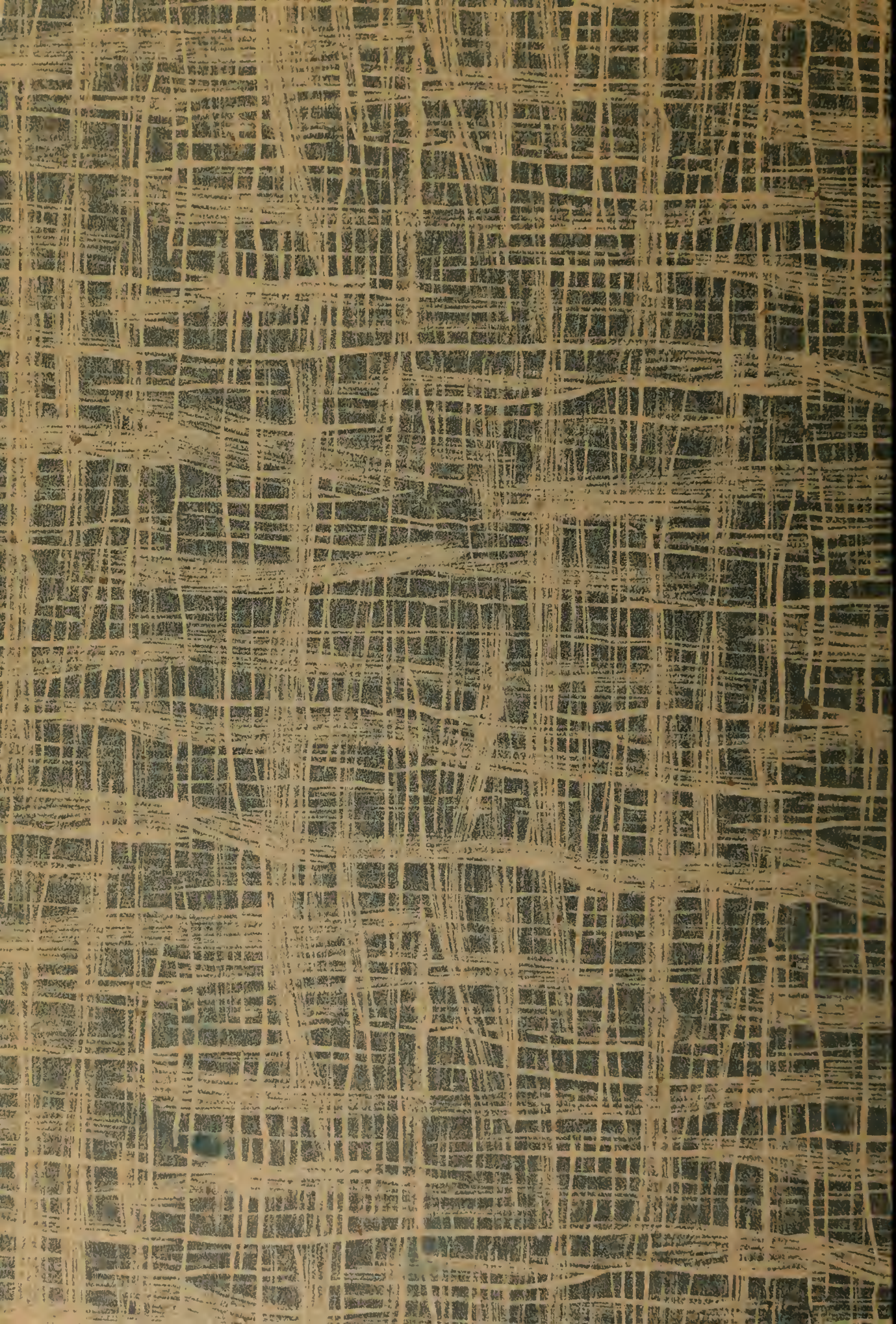
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